May-June 1952

METAL TREATING

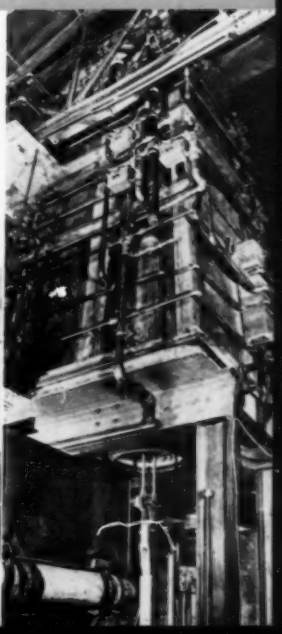
MTI
MASTER CRAFTSMEN
METAL TREATING INSTITUTE

JOURNAL OF THE METAL TREATING INSTITUTE

National Trade Association of

COMMERCIAL HEAT TREATERS

METLAB CO. (Metallurgical Laboratories, Inc.)
Philadelphia, Pa.
Largest Commercial Heat Treaters in the Eastern United States—Member of the MTI
Air view showing the three main buildings housing complete, diversified heat treating facilities; maintenance shop; laboratory; garage; receiving yard; parking area; railroad siding; gate house; recreation field; swimming pool.



Metlab's exclusive "inverted pit" vertical furnace for quenching long, slender parts.

Bell type furnaces—a part of commercial nitriding facilities—largest in U.S.A.

MORE UNIVERSALLY USED THAN ANY OTHER

Aluminum Heat Treating Method

No other method can match these efficiencies!

SPEEDIER PRODUCTION—Work comes up to required temperature almost the instant it is immersed in the bath. *More batches can be handled in far less time!*

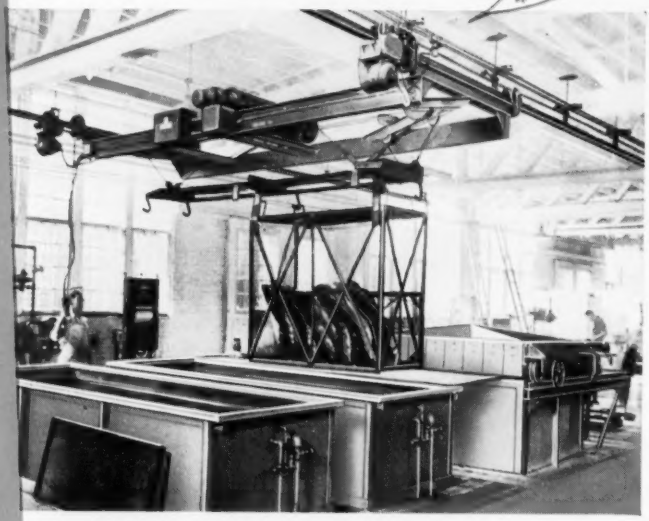
MORE ACCURATE, MORE UNIFORM HEATING—Temperature does not vary more than 5°F. in any part of the bath. All parts of the work are heated quickly and *evenly*. Careful stacking is not a problem. Because of fast, uniform heating, it is possible to charge simultaneously a wide variation of gage sizes requiring different heating cycles.

SIMPLIFIED QUENCHING—MINIMUM WARPAGE—Work from an Ajax Salt Bath can be removed and quenched in a matter of seconds, thus retaining the properties of the aluminum unimpaired. Pieces can be handled individually or in batches suspended in fixtures. Distortion of parts is reduced to a minimum and much expensive hand forming and straightening can be eliminated. An entire load need not be quenched at once, thus making it easy to keep a flow of parts to the next operation without storage refrigerators.

REAL PRODUCT PROTECTION—Because molten salt is the fastest heating medium known, grain growth is eliminated. The salt film eliminates oxidation and retards air chill on transfer to the quench. In handling clad metal, the fast, uniform heating avoids diffusion, so that corrosion resistant properties are unimpaired.

FAST, CLEAN—BUILT TO LAST—The fast production obtainable from an Ajax furnace cuts costs materially. The furnaces are clean. They're easy to operate without skilled labor. Ten or twelve years of *continuous* operation without pot, electrode or other failure has been the universal experience of Ajax users.

. . . solution heat treatment or annealing



Solution heat treatment of large stampings. Tramrail hoist equipped with cage fixture transfers work from salt bath (at right) to water quench and finally to water rinse tank.

During World War II, Ajax Electric Salt Bath Furnaces were used by virtually every leading aircraft component and equipment manufacturer for heat treating aluminum parts.

More salt baths were used for aluminum solution heat treating than any other furnace type—and this same strong preference is equally evident in today's defense production program.

As proved in hundreds of installations, the Ajax Electric Salt Bath offers outstanding advantages in this field—from heat treating rivets, gussets or short extrusions to large formed parts such as ribs, stretched skins or almost any other aircraft aluminum component.

If it's aluminum, the record proves it can be heat treated better, faster, more accurately and more efficiently the Ajax Salt Bath way!

AJAX ELECTRIC COMPANY, INC.

WORLD'S LARGEST MANUFACTURER OF ELECTRIC HEAT TREATING FURNACES EXCLUSIVELY

940 Frankford Avenue Philadelphia 23, Pa.

In Canada: Canadian General Electric Co., Ltd., Toronto, Ont.

SELF-REJETTING • SELF-CIRCULATING

AJAX HYTHERM

ELECTRIC SALT BATH FURNACES

Editorial...

THE HEAT TREATING INDUSTRY MUST TRAIN MEN FOR THE FUTURE

Experienced men in the field have said that it takes anywhere from two to four years to train an expert, all-round heat treater. The importance of the vocation has properly been recognized by the Department of Labor who last year established it as "critical" so as to reduce to a minimum manpower losses within the heat treating industry as a result of Selective Service. It is an ironic fact, however, that the industry itself has not been at all alert to the growing danger of serious shortages of skilled heat treaters caused by an almost total lack of training of young men as apprentices to the trade. In addition, vocational schools have not been properly stimulated by the industry to devote their attention to the trade or establish any sort of training curriculum for it.

Alert members of the Metal Treating Institute recognized this situation recently, established a Committee and, with the cooperation of the Bureau of Apprenticeship, have succeeded in setting up specific Standards of Apprenticeship for the heating treating trade for both union and non-union shops. These standards have been accepted by the Department of Labor. They are equally applicable to the commercial heat treating shop and the industrial manufacturing concern who operates a heat treating department. They provide a pattern for action and will prove of real assistance to any company who wishes to begin training young men in those widely important skills which are a function of expert heat treating personnel.

Local representatives of the Bureau of Apprenticeship are available for practical guidance in setting up the program. Copies of these standards are available to readers of METAL TREATING.

Survey your personnel situation and plan now to inaugurate an Apprenticeship Training Program.

METAL TREATING

Official Journal of the Metal Treating Institute

CONTENTS

Vol. III MAY-JUNE 1952 No. 3

FEATURES

DEPARTMENTS

C. E. HERINGTON, *Editor*
HORACE C. KNERR, *Chairman, Publication Committee*

SALES REPRESENTATIVES

FRANK J. ENRIGHT
1836 Euclid Avenue
Cleveland 15, O.
Prospect 1-4584

LARRY CROSBY
516 Fifth Avenue
New York 36, N. Y.
MU 2-3383

Published by the Metal Treating Institute, 271 North Avenue, New Rochelle, N. Y.

Ipsen Atmosphere Furnace for Bright Heat Treating

By Robert Krogh and Edward J. Rupert
Metallurgists

EDITOR'S NOTE: This issue of METAL TREATING presents the fifth and final descriptive article of our symposium series on the subject of batch type heat treating furnaces. Users of this and the equipment described in the January-February, March-April issues are invited to send us articles or comments on their applications of these furnaces.

Ipsen Industries Inc. is one of the pioneers in the development of the automatic controlled atmosphere batch type furnace for bright and scale-free heat treating. Essentially, this equipment embodies similar principles of basic design to most of the types previously discussed in this furnace symposium*; the ultimate objective is to provide a versatile, all-purpose unit for clean, controlled processing of a variety of parts.

The modern furnace, in fact, should be considered as a heat treating tool or machine, in which, through control of the variables such as temperature, rate of heating, time and atmospheres, work may be consistently duplicated. Competition necessitates quality work, rejects, distortion, breakage and rework must be minimized. Through continued research in heat treating techniques and furnace design, most of these factors are no longer problems of any great import.

Due to fluctuations in quantity and type of incoming work, versatility in functioning is of utmost importance as a means of minimizing down or idling time, essential to production economy. Initial cost has become a less important consideration in selection of equipment, while savings in labor, production efficiency, and elimination or reduction of operations following heat treatment have become increasingly a factor.

The Ipsen Series T Units embody exclusive developments in furnace design, featuring brightness and cleanliness of work combined with simplicity of operation (Fig. 1). The furnaces are available for gas or electric operation, which permits its use in areas where available utilities may be a factor.

Design Feature Straight-Through Operation

The units now available for a range of productive capacities were first developed for the commercial heat treat shop. After considerable investigation, a 250 lb./hr. unit was deemed most practical for this application. Recent designs still employ similar operational features and we now consider this furnace type as a standard unit. Lot production methods have therefore been possible, and the sale of a "packaged" unit allows complete assembly at our plant, eliminating field erection problems.

Several engineering features are worthy of note, and differ from the other furnaces previously discussed. The basic difference pertains to "straight through" transfer of material. The conventional batch furnace is usually charged and discharged through a common door opening at the front. This may necessitate nominal delays in recharging the furnace until after completion of the quenching cycle and the previous load is removed from the furnace. In the Ipsen design, such a possibility has been eliminated by providing both a charge and discharge door; the heating chamber may be recharged immediately following the transfer of the work into the cooling chamber or quench tank. This principle is very desirable, especially on applications involving atmosphere cooling, such as required for annealing, stress-relieving, or slow-cooling on carburizing procedures. These loads can be cooled in atmosphere to 300-400 Deg. F., allowing immediate charging of "follow-up" loads, without affecting the bright, scale free result. Delays up to 2 hours may thereby be eliminated.

Air Tight Doors Complete Atmosphere Seal

It is generally known that air contamination or pickup in the quenching oil affects the ultimate brightness of the work. Any oil surface exposed to

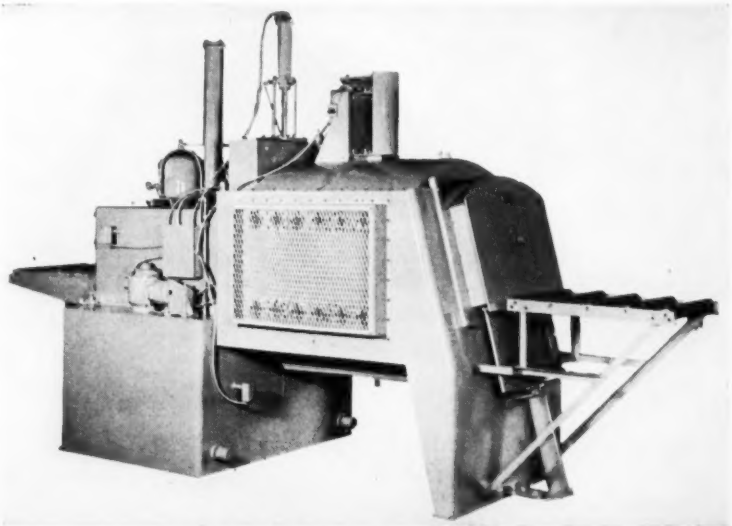


Fig. 1—The Ipsen Series T Atmosphere Furnace.

* *Metal Treating—Jan.-Feb.; Mar.-April.*

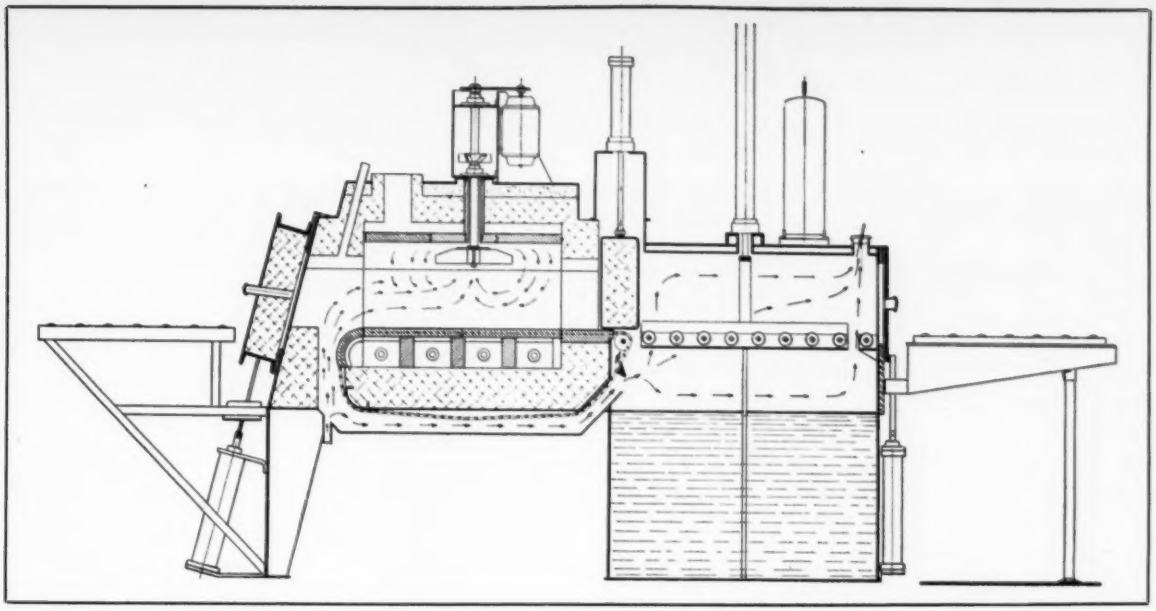


Fig. 2—Operating Features of the Ipsen Atmosphere Unit.

the air will entrap varying amounts of oxygen, especially under conditions of agitation. Discoloration of work from this source would be especially pronounced on heavier sections, due to slower cooling rates. This is overcome in the design of Ipsen Units by utilizing a complete atmosphere seal throughout the entire unit by employing spring loaded, air tight doors.

A novel transfer mechanism is employed for transfer of the work trays. Two continuous alloy chains and attached lugs, with motor driven sprocket drive, provide a practical method of locomotion, allowing only the cold chain section to move the work. When the chain hearth motor is energized, it brings relatively cool chain, and lugs for pushing, from below the hearth into the heating chamber. The hot portion, formerly in the hot zone of the furnace has then traveled approximately one half cycle, and is positioned under the heating chamber. Therefore, all the work load is applied on the cold portion as the chain lugs carry the tray into the quench chamber eliminating any danger of damaging the chain.

The cooling chamber is completely water jacketed with aquastat control of the circulating water. In addition, the oil bath temperature is regulated by water circulation through a series of finned coils. In this manner there is no danger of overheating the oil bath. For special applications, heaters can be installed for use on modified martempering applications.

Three Degrees of Agitation

Agitation provisions in the quench tank are also worthy of note. Three degrees of agitation are available; still oil, moderate flow, and high flow. Baffles regulate the path of flow in a downward direction through the work, which tends to hold parts in the basket. Normal procedures require the initial severe quenching rate provided by the high speed setting until a temperature below the critical range of 1000°-1200° F. is reached, and thereafter, the more moderate flow until martensite transformation is complete. This arrangement is very desirable when considering the variations in critical cooling rate requirements for the standard grades of steels now on the market.

An added feature of interest in plant layout considerations is the portability of the units. Any location providing gas, electric, power and air connections is suitable. No special foundations, pits or trenches are required for installation. In the event of re-location installation requirements are simplified and more economical.

Simplicity and Flexibility Increase Efficiency

Aided by the push button time cycle, quench cycle control and indicating signal lights together with the automatic transfer and quench of a charge, the operation of the furnace is reduced to a simple loading and unloading detail. Thus furnace operators can be quickly trained to handle the equipment. (Fig. 2).

Besides being a leading unit for bright carbo-nitriding, the furnace is easily adapted by adjusting gas flows on the carbo-nitriding panel to other heat treating processes including bright hardening, bright annealing and stress relieving and bright carburization and carbon recovery. In a single day's operation, several of the above processes can be utilized or the furnace can be operated continuously for a desired process. This simplicity of operation and the varied selection of heat treating processes have been provided with the objective of achieving greater efficiency for the commercial heat treating plant or industrial department.

Practical Aspects of Tool and Die Heat Treatment*

By Edward J. Pavesic, *Research Director*
Lindberg Steel Treating Co.

The heat treatment of tools and dies, once considered a rare art, has in recent years been established as more or less of an exact science. This has been due largely to (1) a general increase in knowledge and improvements in techniques related to the manufacture of tool steels; (2) the development and more widespread use of improved heat treating equipment; (3) increase in knowledge concerning the properties of the various classes of tool steels, with the result that applications to the widely varied uses of tools and dies are more sound, and (4) a greater understanding among tool designers and engineers of the part that design of the tool or die plays in heat treatment and subsequent service performance.**

Over a period of years, it has been shown by experience that cracking and/or breakage in straightening during or after heat treatment is the greatest single cause of heat treating failures. This is due not so much to bad straightening practice as to errors of commission and omission integrated into tools and dies on the drawing board, in the tool room and in the purchasing agent's office. Such errors as improper selection of steel, bad design, failure to remove "mill bark" or decarburization, abusive machining practice, and imposition of straightness tolerances too small to be practical are the principal causes of breaking or cracking even though the straightener (heat treater) is blamed.

Other direct causes of failures (not cracked or broken in straightening) in heat treatment are: (1) improper treatment; (2) defective material, e.g. surface defects, internal ruptures, excessive segregation and overheating in forging; (3) bad design for the type of steel used; (4) bar decarburization; (5) residual stresses which are a function of hardenability, design and heat treating technique; and (6) deep stamp marks which act as stress raisers.

In spite of our increased knowledge of the science of heat treating, it is imperative that in order to avoid failures in heat treatment, every phase of manufacture of a tool or die must be co-ordinated and closely controlled at all times. This requires the cooperation of the steel maker, the designer, the tool maker and the heat treater.

Selection of the Tool or Die Material

The selection of the material to be used for a given tool is predicated upon a number of factors such as type of material being formed, blanked or cut, the volume of production desired, and to a great extent upon its design. However, for any specific material, the heat treating technique will vary with design; hence is apparent that selection of material, design and heat treatment must be considered simultaneously in order to produce a tool worthy of praise.

Regardless of the type of material selected for a given tool, there are certain cardinal rules that should be observed.

The *chemical analysis* of the tool steel should conform to established standards. High chemistry heats as well as low chemistry heats may be detriments to successful heat treatment. Hardness, depth of hardening, size change, and warpage can be affected by variations in chemical analysis. Propensity to cracking may also be increased by improper analyses.

The tool steel should be free of *physical defects* such as seams, rolling or forging laps and breaks on the surfaces since these defects are potential foci for cracking during heat treatment. Internal defects such as piping, forging bursts, flakes or ruptures are more difficult to detect and yet are serious offenders in the cracking of parts during heat treatment. Overheating in forging which can cause burning and/or excessive grain growth generally results in cracking of the tool or die. Figures 1 and 2 show a carbon tool steel die which cracked as a result of severe grain growth which occurred in overheating for forging.

Severe carbide and alloy *segregation* at the center of a bar may also act as focus for cracking, and especially so when exposed to a surface in a longitudinal plane.

Decarburization present on a rolled or forged bar is harmful in several respects. First, it alters the maximum hardness attainable; secondly, the transformation or hardening characteristics of the decarburized layer differ from those of the parent metal thereby setting up additional stresses in hardening and increasing susceptibility to cracking. In addition, when present on thin sections, decarburization increases the amount of warpage in heat treatment. There is only one remedy for decarburization when it is present and that is, its complete removal before heat treatment.

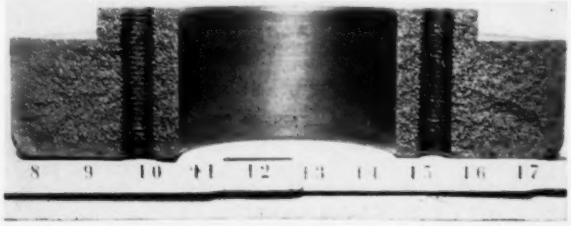


Fig. 1—Fractured surfaces of cracked water hardening tool steel die.

* *Presented at the Twentieth Annual Meeting of the American Society of Tool Engineers, Chicago, Ill., March 17-21, 1952. Published by permission.*

** An additional factor might be added, i.e., (5) better understanding of metallurgical principles.—Ed.

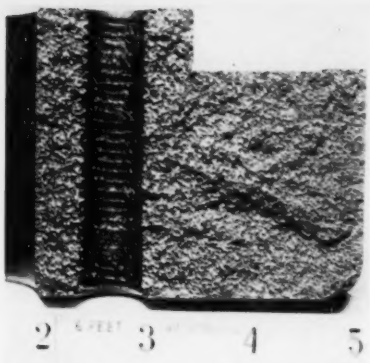


Fig. 2 — Enlarged view of cracked die shown in Fig. 1. Note coarse cubical faceted grain structure.

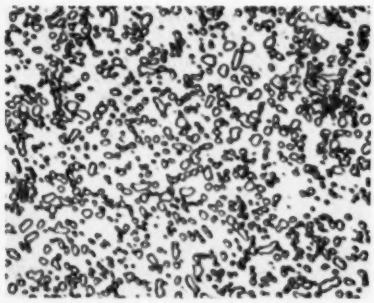


Fig. 3—Microstructure of annealed carbon tool steel. The spheroidization is essential to good control in heat treatment. X500 4% Picral Etch.

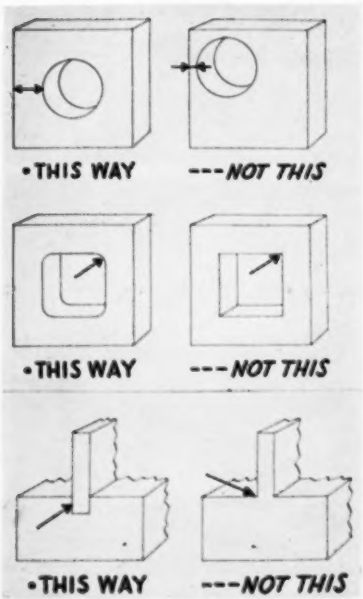


Fig. 4—Design malpractices which increase heat treating hazards and suggestions for correcting same.

Tool steels should be in a fully annealed condition before hardening. The microstructure should be 100% spheroidized (Fig. 3), which provides maximum machinability and the best possible control of the solution of carbides when heating for hardening. Wear resistance, hardness and dimensional changes may be adversely affected and cracking hazards increased if the steel is not fully annealed.*

Tool Design

The tool designer has additional responsibilities when designing tools which require heat treatment. Quite obviously, the designer should provide generous filleting at changes in section and at the same time eliminate the use of sharp re-entrant angles. The greater the degree of symmetry in a given tool, the less hazardous is its heat treatment. In the case of blanking dies, to cite but one example, it is not uncommon practice to drill holes adjacent to those already present in order to provide for greater uniformity in heating and cooling during the hardening process. The use of sectional dies simplifies heat treating problems and at the same time eases the problems of machining and grinding for the tool maker. Figure 4 illustrates several design malpractices which increase heat treating hazards along with suggested corrective designs.

In the design and manufacture of tools and dies, certain dimensional tolerances are generally permitted, although sometimes they may be quite small. Many parts are finished to size before heat treatment, thus necessitating exacting control to prevent or minimize growth, shrinkage, and distortion during the hardening process.

Growth, shrinkage and distortion are functions of the analysis of the material, design and heat treating technique. Distortion can result from differential heating or cooling, or improper support while heating for hardening. Growth may result from the change in volume that occurs when steel is hardened or it may result from permanent deformation as a result of differential heating or cooling. Shrinkage is governed to a great extent by differential heating or cooling.

Mr. J. Y. Riedel in an article entitled "Distortion of Tool Steel in Heat Treatment",** uses the term "distortion" to describe both dimensional changes and warpage, e.g., out-of-straight, out-of-round, etc. This author proposes that the term "distortion" be used only in conjunction with non-uniform movement with respect to the original surfaces (warpage), while the terms "growth" and "shrinkage" be used only to describe uniform dimensional changes.

The author has conducted size change experiments on similar test rings of a chromium-tungsten oil-hardening tool steel, which indicated that size change was a function of cooling rate when these rings were martempered, oil quenched and brine quenched. Figure 5 illustrates this effect of varying heat treating technique upon dimensional change in similar test rings. All of the test rings were preheated at 900° F., transferred to an atmosphere-controlled furnace at 1440° F., held one hour, and quenched (1) 400° F. salt, (2) 120° F. oil and (3) brine at 68° F., and after measurement were tempered at 400° F. for two hours. Dimensional changes are shown for the "as quenched" and the "quenched and tempered" conditions designated "Q" and "T" respectively on the bargraph for each type of quench. Table I shows the hardnesses after quenching and after tempering.

TABLE I

Hardness Rockwell-C	Martemper	Oil Quench	Brine Quench
As hardened	63	64	65-66
Hardened and tempered	59-60	59-60	60.5-61

* The term "fully annealed" is here intended to mean fully spheroidized.—Ed.

** *Metal Progress*, December 1950; pages 853-859.

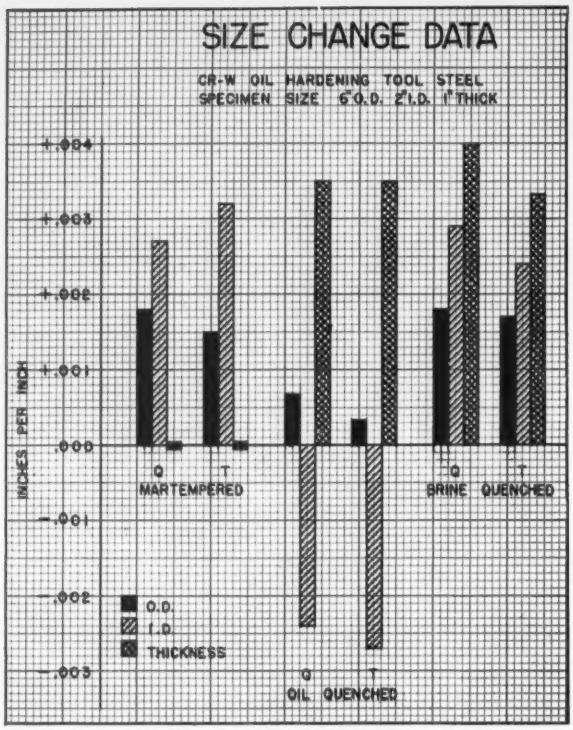


Fig. 5—Bar graph showing results of varying heat treating technique upon size change.

To generalize somewhat on this question of size change, it can be said that if the mass and design of a tool or die varies, the resulting size change (after heat treatment) will also vary.

Heat Treating Practice

In order to successfully harden tools and dies, the heat treater first of all must have the proper equipment. Heating for hardening is best done in controlled-atmosphere furnaces wherein the carbon potential in the furnace is neutral to the carbon content of the tool steel, or in neutral salt baths. Both methods eliminate carburization, decarburization and scaling providing they are closely controlled. (See Figs. 6, 7, 8).

This controlled heat treating may seem costly when compared to former methods. However, it is to be remembered that any tool failures resulting from improper heat treatment are extremely costly.

Temperatures used in hardening should be the minimum necessary to attain the hardness level desired. The use of excessive temperature and/or time will generally result in excessive carbide solution and possible grain growth, which increase cracking hazards and tend to decrease die life. Greater instability may result from austenite which may be retained at room temperature as a result of overheating or oversoaking.

The rate of heating of any tool or die should be kept at a minimum to prevent excessive or differential movement during heating for hardening. It is generally considered good practice to preheat tools during the hardening cycle.

The selection of the proper quenching medium is dictated by the analysis of the material and the design of the tool. Water-hardening tool steels in small sections can be effectively hardened in oil. Large parts made of carbon tool steels can sometimes be time-quenched in water, then transferred to oil in order to minimize distortion and cracking hazards.

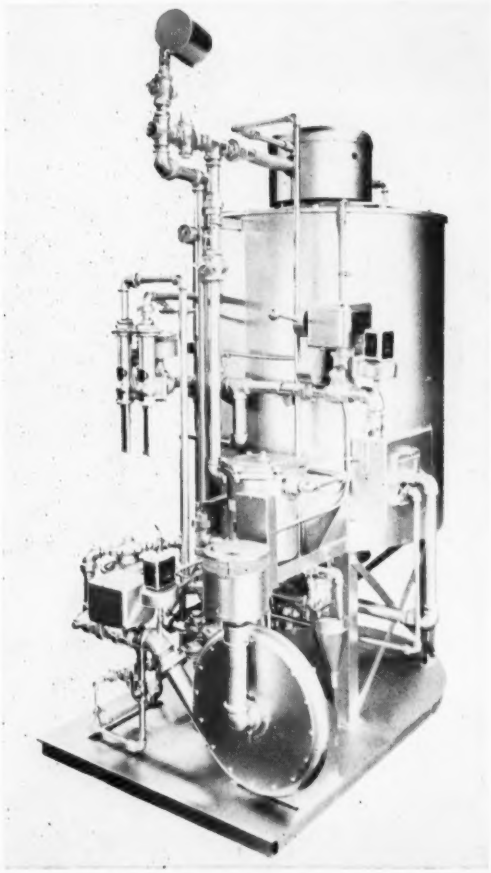


Fig. 6—Modern endothermic generator for the production of neutral atmosphere which can be controlled to cover a wide range of carbon content.

Low-melting-point niter salts and high-temperature

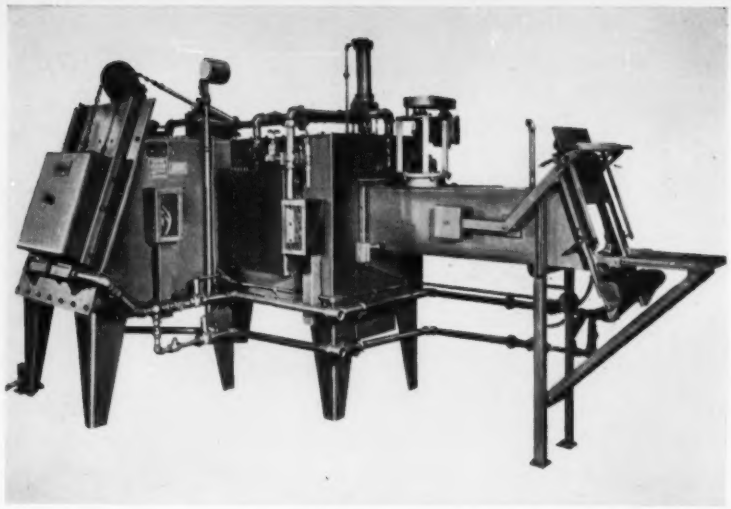


Fig. 7—Modern atmosphere controlled furnace incorporating integrated preheat, high heat and quench zones for heat treatment of tool steels susceptible to hardening by slow rates (e.g. air) of cooling.

quenching oils are extensively used in martempering and/or interrupted quenching to minimize distortion and quenching stresses. In martempering, the quench is arrested at or slightly above the temperature at which the martensitic transformation begins, and the part is allowed to equalize at this temperature. The actual hardening is accomplished by air cooling from this temperaure. Thus, the hardening reaction occurs almost simultaneously at the surface and center of the part so treated, thereby eliminating a major source of severe stresses which usually result from conventional hardening methods.

In a given tool or die, the temperature gradient between the surface and the interior will be less in oil than in water, and will be much less in air than in oil.

Tempering should not be performed until the tool or die is thoroughly hardened. This means that the part should be allowed to transform almost completely to martensite before tempering; otherwise some hardening may take place after the tempering operation. Since the martensitic transformation for many of the tool steels is essentially complete at 100° F. to 150° F., tools should be cooled to at least this range before tempering. For maximum stabilization with commensurate hardness, tools should be tempered for long times at temperatures of 350° F. to 400° F. In the case of high-speed, hot-work, and high-carbon high-chromium steels, a double tempering operation should be performed, since steels of this type exhibit secondary hardening characteristics. Indeed, it would be desirable to double temper any tool steel so long as hardness is not sacrificed.

Straightening is the most hazardous operation the heat treater has to perform. It is preferable to straighten the tool or die before it has completely transformed to martensite, or if possible before transformation has even begun. The transformation characteristics of the steel must be considered when straightening. Hot straightening from the martempering bath is good straightening technique.

The importance of co-ordinating the various phases in the manufacture of a tool or die cannot be overemphasized. The foregoing merely touches upon the innumerable variables which confront the tool engineer in his daily task. Much credit is to be given the tool engineer who will take into consideration these variables when designing a tool or die. Only through consideration of these variables can satisfactory tools and dies be produced at minimum cost.

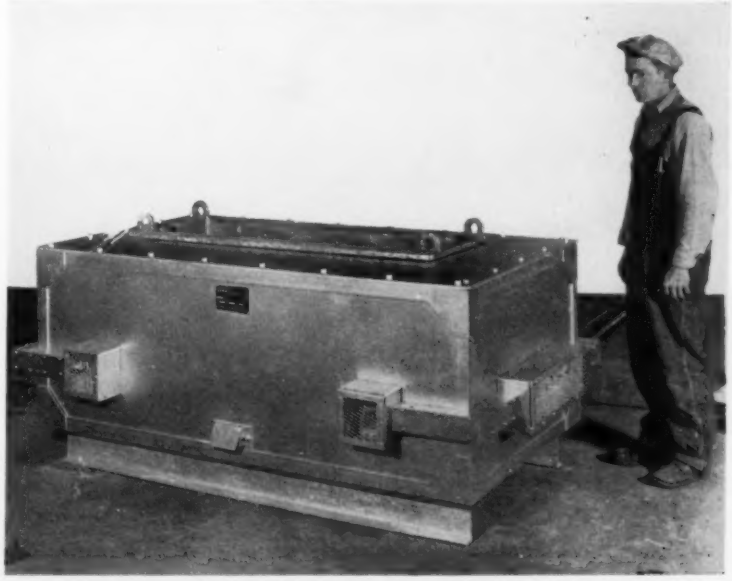
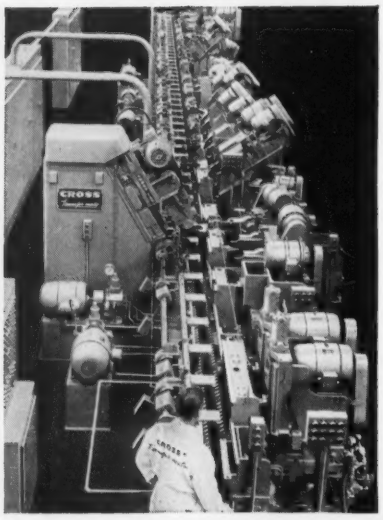
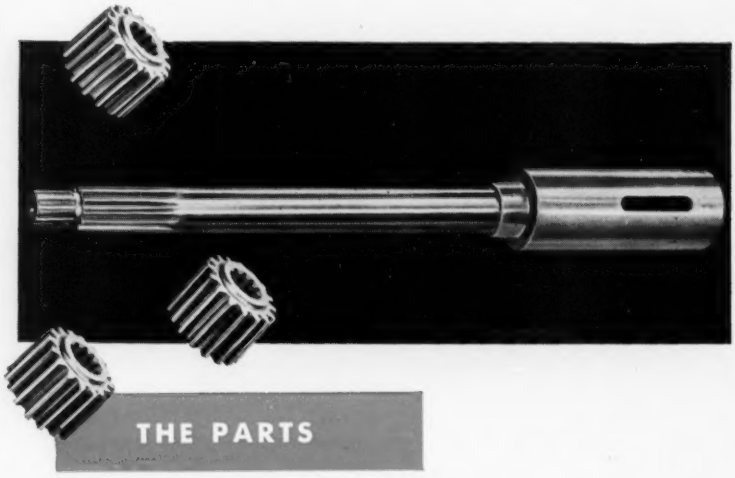


Fig. 8—Neutral salt bath furnace used for heat treating tool steels with freedom from decarburization, carburization and scaling.

The Cross Company increases production, eliminates distortion and scale



. . . AEROHEAT® Heat Treating Compounds Austemper Spindles and Gears of Cross Transfer-matic®



THE TRANSFER-MATIC

Important in the manufacture of this Cross Transfer-matic for the production of automatic transmission housings is the heat treatment of its spindles and gears.

THE PARTS

ADVANTAGES

Using Cyanamid's AEROHEAT 1200 and 300, Cross engineers increased production by speeding up heat treatment . . . eliminated scale and distortion so that gear shaving was no longer required after heat treatment . . . increased hardness and life of gear teeth.

Versatile AEROHEAT 1200 and 300 are also used for martempering other parts, while AEROHEAT 300 alone is used for tempering or drawing.

For effective, money saving results, let Cyanamid's technical service and heat treating compounds team up to help you meet rigid specifications required on defense and civilian contracts . . .

Next time, call Cyanamid first.

Cyanamid's heat treating compounds include:
AEROCARB® Carburizing Compounds
AEROCASE® Case Hardening Compounds
AEROHEAT® Heat Treating Compounds

Spindles and gears are made of A.I.S.I. E-6150 steel. They are brought up to a temperature of 1550°F in AEROHEAT 1200, quenched at 600°F in AEROHEAT 300 and aircooled. Finished hardness: approximately Rockwell C45.

JMT5

AMERICAN Cyanamid COMPANY

INDUSTRIAL CHEMICALS DIVISION

30 Rockefeller Plaza, New York 20, New York

☐ Send technical data sheets on AEROHEAT 300 and 1200.

☐ Have technical representative call.

Name_____ Position_____

Company_____

Address_____

City_____ State_____

DISTRICT OFFICES: Boston • Philadelphia • Baltimore • Charlotte Cleveland • Chicago • Detroit • Kalamazoo • St. Louis • Los Angeles In Canada: North American Cyanamid Limited, Toronto and Montreal

Various Inspection Methods Used in Heat Treating Shops

By STANLEY A. GILL
Magnaflux Corp.

For many centuries the heat treatment of metals has been of vital importance. Most people are familiar with the superior quality of Damascus steel and the methods of heat treatment and quenching used in producing such characteristics. At the present time nearly all metal parts receive heat treatment in one form or another. The importance of heat treating operations to our industrial growth cannot be overemphasized. On heat treating falls the brunt of contributing to industrial progress through the economical use of metal parts. It is the heat treating operation that makes for easier workability, controls grain size, and provides the hardness, strength, and ductility necessary for satisfactory fatigue life in a myriad of parts.

In view of the responsibilities placed on heat treat personnel, considerable training and a great deal of specialized knowledge and experience are necessary. For example, it is oft-times up to them to decide upon heat-treatability, and methods to employ to provide machinability, control grain size, and to produce a high hardness and certain ductility without cracking harmful deformation or unnecessary residual stress. There is the question of the type of metal and its characteristics, which requires complete information on the parts. Failing this, certain preliminary tests must be performed prior to the heat treat operation. At the present time, oral instructions as to the results required are not unusual. Generally, heat treating specifications are provided but they may not include all the essential information and may actually be inaccurate. In this case the experienced heat treater must resort to his know-how and have inspection or test methods available to determine which heat treatment will produce the desired results.

The practical heat treater will agree that sometimes parts are designed without much regard to radical changes in section, drilled or punched holes, etc. which make the heat treating operation extremely difficult, if not impossible. As a matter of fact, a simple visual inspection of the part might indicate to the heat treater that the design was entirely erroneous from a heat treat standpoint. He would then find himself in the position of advising the design engineers to modify the design for an easier and less costly heat treat process.

Analysis of the parts to be heat treated is of primary importance. Their previous processing may also have a bearing on the heat treat problem. In these cases further inspection or tests by the heat treater may be necessary. The alloy may be recognized by spark test, etc. or its hardness checked to determine whether or not annealing or normalizing may be necessary before the complete heat treat cycle.

An additional pitfall to the heat treater is imperfections in the metal such as heavy non-metallic inclusions, or blow holes in castings which cannot be seen visually. Flakes in forgings, seams, or grinding checks may only be located with difficulty by usual visual inspection. In this case the heat treater may decide on etching to be followed by inspection under low magnification. Most heat treaters will agree that macro etching and visual inspection are not entirely satisfactory. They are destructive. They may not reveal minute surface defects. Unless the part is first sectioned they will not show up non-metallic inclusions, or blow-holes. If the metal is fairly hard etching may actually cause pickling cracks. For these reasons a large number of heat treating departments have felt the need of, and many now use, non-destructive testing methods which locate surface and subsurface defects rapidly and with certainty. A brief description of two of the most widely used engineered non-destructive testing methods follow:

Method No. 1 is magnetic particle inspection. This is carried out with Magnaflux equipment and materials, and the method is one of a family of Magnaflux Corporation non-destructive testing methods. A magnetic field is set up in the part in a direction at some angle to that of suspected defects. While the part is

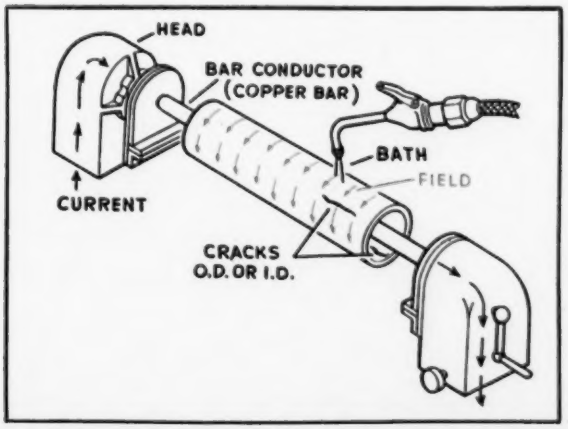


Fig. 1—A central conductor used for circular magnetization to find lengthwise defects. The magnetic field is set up at a right angle to the flow of current. The bath contains the magnetic particles.

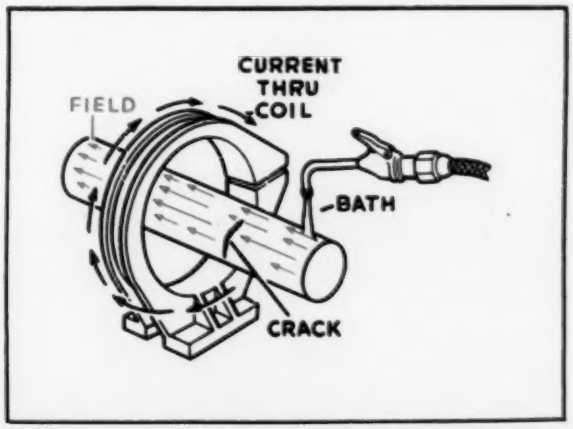


Fig. 2—Shows how current passed through a coil magnetizes the part lengthwise to find transverse defects when the bath of magnetic particles is applied.

being magnetized, magnetic particles (suspended in oil) are sprayed on to the part so that all sections of the part are covered with the liquid carrying the particles. A defect causes a magnetic leakage field which attracts the particles so as to form an outline directly over the defect. This outline or indication locates and shows the extent of the defect. If a defect is surface, there is a sharp high build-up of the indication. If the defect is sub-surface, the magnetic particle pattern will be flat, broad, and fuzzy. Thus the nature of the defect can be inferred from the indication. Generally speaking, seams, inclusions, etc. will be parallel to the longitudinal axis and will be shown as indicated in Figure 1.

Other types of defects which can be discovered during heat treating may be in a transverse direction. These will be shown by the technique as described in Figure 2, where a magnetic field is induced lengthwise in the part.

A new development of Magnaflux Corporation now in use for approximately two years, is known by the trade name Duovec. By this method it is possible to magnetize in two or more directions in the same operation. This means that defects located in a longitudinal or transverse direction can be shown up and found *by one,* rather than two, inspections.

The magnetic particle inspection methods are, of course, limited to the inspection of ferro magnetic materials. They cannot be applied to non-magnetic materials such as austenitic stainless steel, aluminum, magnesium, or copper alloys. For these metals, and other materials, Magnaflux Corporation, in 1942, developed an inspection method known by the trade name of Zyglo. (Method No. 2).

Zyglo employs fluorescent penetrants to locate defects in metals and solid materials. Standard type equipment for this process is shown in Figure 3. Inspection with Zyglo consists of five steps: (1) Zyglo Penetrant is applied to the part which is allowed to drain while penetrant is drawn into cracks and other discontinuities; (2) Excess penetrant is removed from the surface of the part by water washing; (3) The part is completely dried in a hot-air, recirculating drier; (4) Zyglo Developing Powder is applied to the part; and (5) the part is examined under near-ultra-

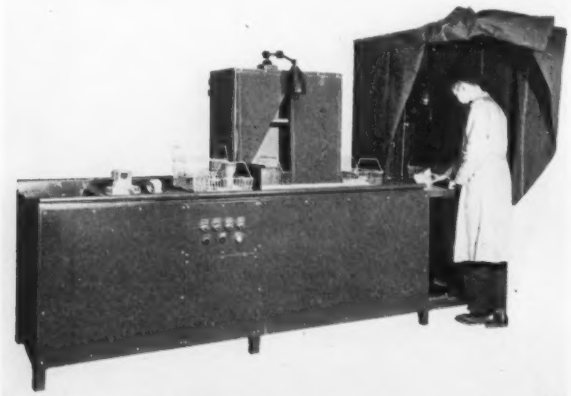


Fig. 3—Is a small Zyglo Unit for fluorescent penetrant inspection. The unit was developed for production inspection of small parts, of tools, for overhaul inspection of small and medium sized parts and in sampling and quality control inspection.

Fig. 4—Shows a portable unit for magnetic particle inspection by Magnaflux or Magnaglo. This unit will handle parts up to 54" long and 10" in diameter. Both circular and longitudinal magnetization may be done on this unit.

violet or "black light" in a darkened area, and each defect is seen, as marked by a fluorescent line of light on the part itself. In some applications, the developing material used is a colloidal suspension of Zyglo Wet Developer which is applied to parts after washing and before drying. Semi-automatic conveyorized production equipment for the Zyglo process is also used by the manufacturing industries, particularly in the aircraft and automotive fields.

Magnetic particle inspection is widely used in heat treat departments (1) to establish correct heat treat procedure in initial runs or on a pilot basis; and (2) for periodic sampling inspection per heat, or on a time basis. For example, portable equipment as shown in Figure 4 is used extensively for such control. It is readily moved, employs the wet method with Magnaglo (fluorescent magnetic particle inspection), and is used by the travelling inspector for periodic sampling in the heat treat department.

Before heat treating it is often desirable to check parts for defects at or near the surface which could cause heat treating difficulties. One such type is heavy non-metallic sub-surface inclusions which can result in high residual stresses and cracking during the quenching operation. Even though they could be quenched without producing cracks, the high residual stress, if followed by grinding or pickling, would eventually cause cracking. On the other hand, the problem defects in parts prior to heat treat may be minute cracks such as shrinks in castings, or flakes or laps in forgings, which will open up in heat treat. These can rapidly be located by inspection with Magnaglo.

With Magnaglo inspection it is possible to get immediate results after heat treating, quenching, tempering, etc. Even the most minute checks will show up as brilliant lines thereby attracting the inspector's attention and providing the basis for immediate correction of the process causing defects. A typical heat treat crack is shown in Figure 5.

As mentioned in the foregoing, periodic sampling inspection of parts as heat treating progresses is a

Fig. 5—Magnaglo indications of cracks caused by heat treating, enabling prompt correction.

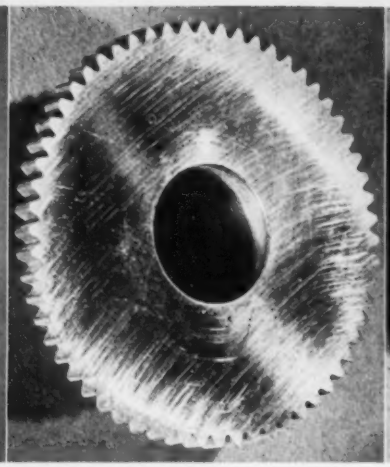


Fig. 6—Is a gear as it appeared under visual inspection.

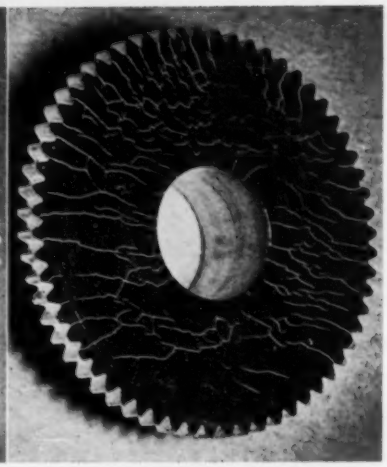


Fig. 7—Is the same gear under Magnaglo.

normal inspection practice. In this manner it is possible to keep the process under control by inspecting periodically—perhaps on a 30 minute basis. If defects are being produced and are located at one such inspection but not at previous inspections, then the heat treating process went out of control during the last 30 minute period. In addition to correcting the process, it would then also be possible to screen the parts treated during this period by 100% inspection and eliminate any possible defectives.

Grinding, the process preceding it, such as forging; and the heat treat operation used in conjunction with grinding, all tend to produce relatively expensive parts. Sometimes they are of high hardness with high residual stresses. Sometimes, of course, the grinders are at fault and produce grinding checks and consequent scrap. At other times, the problem may be strictly heat treating. Often the part may be at the high hardness side of the specification. Grinding and regrinding will add to the residual stresses to cause cracking. In such cases it is at times necessary to stress relieve even between grindings. At the very minimum it is essential that the parts be maintained within the hardness limits and preferably on the low side of such. Visual indications of one type of grinding checks are shown in Figure 6 and as revealed by Magnaglo in Fig. 7.

Fluorescent penetrant inspection methods as indicated previously, confine Zyglo largely to non-magnetic metals. (Fig. 8.) Their use in establishing the correct heat treat procedure and helping to maintain control, are similar to those described for magnetic particle inspection. Typical defects located include heat treat cracks; cold shuts, and flash line cracks in forgings; shrinkage and porosity and other typical casting defects. It may be of interest to note that blisters, which tend to follow the flow lines on aluminum forgings, will normally not show up until after heat treating, but that their origin can be traced to conditions in the original ingot.

As indicated previously these various inspection methods are used quite extensively. In some cases on critical automotive parts 100% inspection is desirable, and for this or similar purposes, production speeds of up to 3000 parts per hour can be obtained with a minimum of materials handling. In aircraft manufacture, Air Force and Navy aeronautical specifications often require 100% inspection by one or another of the methods. As this is a final inspection where parts are either accepted or rejected it adds to the manufacturing cost. On the other hand, the in-process inspections to establish correct procedures and to control processes with minimum inspection, prevents the production of scrap. For this reason they are economical, and are specified by many leading manufacturers of the products we use in our every day life. These range all the way from sewing machines to diesel locomotives, and from hand chisels to passenger cars.

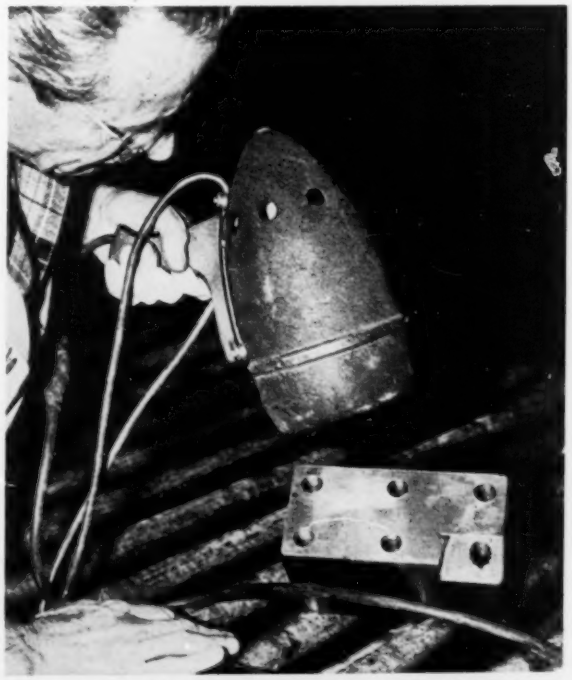


Fig. 8—Shows a part being inspected with Zyglo.

BEFORE-

BUYING NEW EQUIPMENT OR EXPANDING PRESENT FACILITIES CONSULT A...

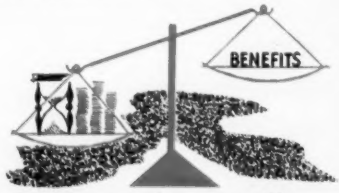
COMMERCIAL HEAT TREATER

MTI MASTER CRAFTSMEN METAL TREATING INSTITUTE

If you are faced with the sudden need to produce prime or sub-contract work for the Rearmament Program which requires heat treatment, before establishing a new department or expanding your present facilities, check with a MTI commercial heat treater. There are a number of reasons for this.

First of all, it is likely that there is a commercial plant located near you that will not only have the facilities and equipment, but the skill and experience to perform the heat treating operations required, whatever they may be.

Secondly, the establishment of a new department or the expansion of your present one would require an inordinate amount of time and investment; — out of proportion to the benefits which might result.



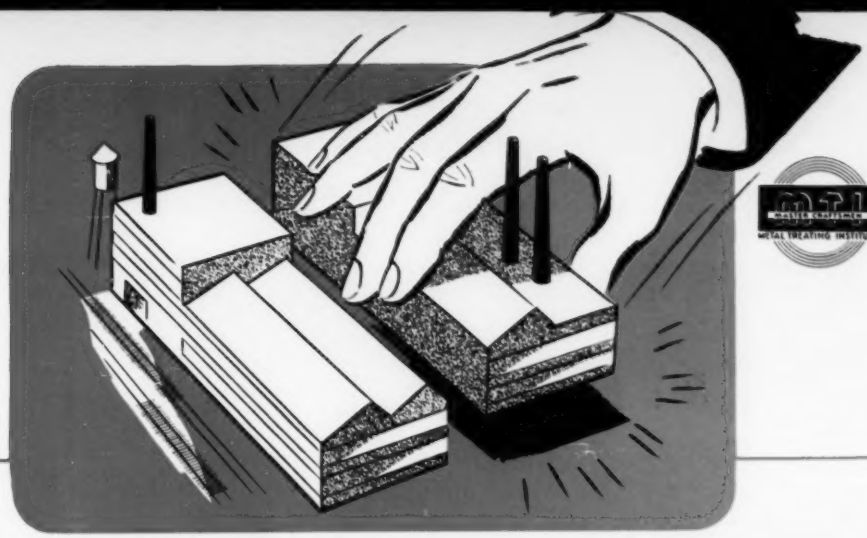
Thirdly, the new plant or department or equipment will, when the need for it no longer exists, only stand idle or be scrapped. This was proved painfully in the recent post-war years.

Finally, even if only government money is involved, remember this is *your* money and the economical handling of it will be to your benefit.

If you are faced with heat treating problems or the need for heat treating services, write

METAL TREATING INSTITUTE 271 NORTH AVENUE NEW ROCHELLE, N. Y.

or consult the MTI members listed on the following page.



For the BEST in Heat Treating Consult these Companies:

CALIFORNIA

California-Doran Heat Treating Co.
2850 E. Washington Blvd., Los Angeles 23
Cook Heat Treating Corp.
5934 Alcoa Ave., Los Angeles 11
Hollywood Heat Treating Co.
1046 No. Orange Drive, Los Angeles 38
Lindberg Steel Treating Co.
3537 East 16th St., Los Angeles 23
Dexter Metal Treating Co.
1026–77th Ave., Oakland 21
Industrial Steel Treating Co.
600 Fallon St., Oakland 7

COLORADO

Metal Treating & Research Co.
651 Sherman St., Denver 3

CONNECTICUT

Commercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
Stanley P. Rockwell Co.
296 Homestead Ave., Hartford 5

ILLINOIS

Senecca Heat Treating Co.
70 S. Batavia Ave., Batavia
Accurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
Chicago Steel Treating Co.
333 North California, Chicago
Dura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
Lindberg Steel Treating Co.
222 North Laflin St., Chicago 7
Pearson Industrial Steel Treating
5757 Ogden Ave., Chicago 50
Perfection Tool & Metal Heat Treating Co.
1740 West Hubbard St., Chicago 22
Fred A. Snow Co.
1942 West Kenzie St., Chicago 22
American Steel Treating Co.
P. O. Box A, Crystal Lake
Eklund Metal Treating, Inc.
721 Beacon St., Love Park
O. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford

INDIANA

Nerl Heat Treat Corp.
1824 So. Franklin St., South Bend 23

MARYLAND

Maryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

New England Metallurgical Corp.
9 Alger St., South Boston 27
Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43
Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit

MINNESOTA

Metallurgical Control Labs.
2226 East Lake St., Minneapolis 7

MISSOURI

Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Heat Treating Co.
611 Grove St., Elizabeth
American Metal Treatment Co.
Highway 25 and LaFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Steel Treating Co.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12
Alfred Heller Heat Treating Co.
391 Pearl St., New York 7
Metro Heat Treat Corp.
466 Broome St., New York 13
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Cincinnati Steel Treating Co.
Wooster Pike & Mariemont Ave.,
Cincinnati 27
Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
1265-71 East 55th St., Cleveland 14
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14
Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16
Dayton Forge & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher
J. W. Rex Co.
834 West Third St., Lansdale
The Drever Company
220 West Cambria St., Philadelphia 33
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 East Mermaid Lane, Philadelphia 18
Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32
Ferrotherm Company
4911 Butler St., Pittsburgh
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11

WISCONSIN

Wesley Heat Treating Co.
825 South 21st St., Manitowoc
Hushek Metal Processing Co.
1536 West Pierce St., Milwaukee
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wesley Steel Treating Co.
1301-1403 West Pierce St., Milwaukee
Harris Metals Treating Co.
1745 Taylor Ave., Racine
Spindler Metal Processing Co.
2338 Mead St., Racine
Wesley Metal Treating Co.
2320 Mead St., Racine

HEAT TREATING HINTS

INVESTIGATION OF A COMMERCIAL CARBURIZING COMPOUND*

Being interested in finding a Middle West supplier of commercial carburizing material, and incidentally, saving freight and storage space, we ran a test on a sample of carburizing material, the methods and results of which may be interesting to the readers of METAL TREATING. The purpose of the test was to learn the rate of penetration obtainable from this material under normal carburizing conditions and the effect of repeated use of the compound with only enough additions of fresh material to replace shrinkage. This was found to be about ten percent (10%) after each heat.

A series of specimens cut from two rods of SAE 1020 steel, of ⅜ in. diameter and ¼ in. diameter, were used. One of each of these was placed in a small carburizing container 4 ins. diameter by 5 ins. high.

This container, or pot, was placed in a furnace having a heating space 30" by 16" by 72" which had already been heated to carburizing temperature 1750° F. with a ton load of carburizing work already in it. The sample container was allowed to remain in the furnace for nine hours and then removed. The actual time at carburizing heat was, therefore, somewhat less than this, depending upon the rate of penetration to the center of the small container. This, of course, was about the same for all the successive runs.

The purpose of the test was to determine whether, with approximately ten percent (10%) additions of fresh material, the carburizer could be used over and over with uniform results.

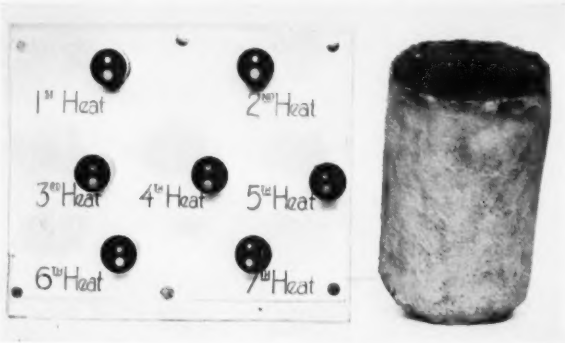
To measure case depth, the specimens were sectioned and mounted in plastic holders as illustrated in the photograph. Each holder contains a ⅜ in. and a ¼ in. sample which were run together in one heat. (The specimen numbers and the heat numbers do not correspond. The heat numbers govern.)

Results were as follows:

	Samples	
	⅜	¼
1st heat	.055"	.050"
2nd "	.037"	.037"
3rd "	.045"	.045"
4th "	.040"	.045"
5th "	.055"	.050"
6th "	.045"	.045"
7th "	.055"	.055"

From these results it is evident that there is some variation between the case depth obtained in successive heats due perhaps to experimental conditions, but that the rate of penetration remains reasonably constant, namely .040 to .055 ins. The value .037 obtained on the second heat is believed to be due to an operator's error.

This shows a rather low rate of penetration, with good endurance of the carburizing material, which is a customary combination. ASM Handbook indicates that nine hours at 1750° F. should give approximately .095 ins. case, but if three hours is allowed for heating the 4 in. diameter pot to the center where



the specimen is located, the six hours at heat should give about .075 ins. case with a very active carburizing material. Such a carburizing compound shrinks faster and requires more replacement.

As a further check upon case depth gained each hour, the following figures are given:

1st hour	—	.007	6th hour	—	.005
2nd hour	—	.007	7th hour	—	.005
3rd hour	—	.006	8th hour	—	.005
4th hour	—	.005	9th hour	—	.004
5th hour	—	.005			

Total approximately .040 to .050 inches.

By CLARENCE F. GRAHAM, *Metal Treating, Inc., Milwaukee, Wis.*

"UN-MACHINABLE GRAY IRON CASTINGS SALVAGED BY ANNEALING"

Recently a local manufacturer of textile machinery brought to us some small gray iron castings, poured in his own foundry, which were too hard to machine. Examples are shown in Fig. 1.

Metallurgical investigation was undertaken to determine the cause of hardness and to develop an annealing treatment. Chemical analysis was as follows:

Combined carbon	1.05%
Total carbon	3.38%
Phosphorus	.446%
Sulphur	.201%
Silicon	2.28%

Brinell Hardness was 241.

Photomicrographs "as cast", are shown in Figs. 2 and 4.

The high percentage of combined carbon and the microstructure show that the machining difficulty was due to free carbides rather finely distributed. The

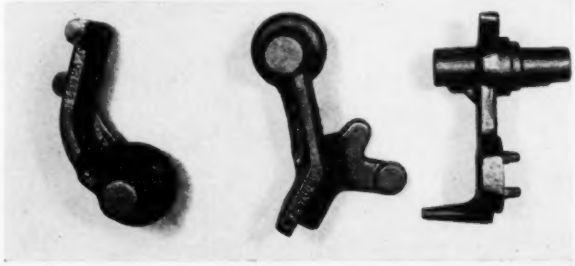


Fig. 1

* Obtained from G. S. Rogers Company, RR 4 Box 338, Kenosha, Wisconsin known as No. 18 non-burn, size ⅛" to ¾". These results are given as technical information only and are not intended either as a recommendation of this compound or otherwise.—Ed.

hardness figure is misleading as the carbide itself is well above Brinell 627.

Our customer attributed the presence of free carbide to his inability to obtain proper iron and scrap to charge his cupola.

After studying the microstructure it was decided to try a simple anneal at 1450° F. rather than to use the customery 1700°-1750° F. anneal for breaking down massive carbide. It worked.

As a result of annealing at 1450° F. for four hours, followed by very slow cooling between 1350°-1150° F., the cast iron was completely graphitized as shown in Figs. 3 and 5. The hardness dropped to Brinell 146 and the castings were readily machinable.

This case history cites another example of how the commercial heat treater can materially assist a customer by supplying, not only furnace service, but also the laboratory facilities and metallurgical knowledge to reduce a problem to its simplest elements.

GEORGE SCHIEL, *Metlab Co., Philadelphia, Pa.*

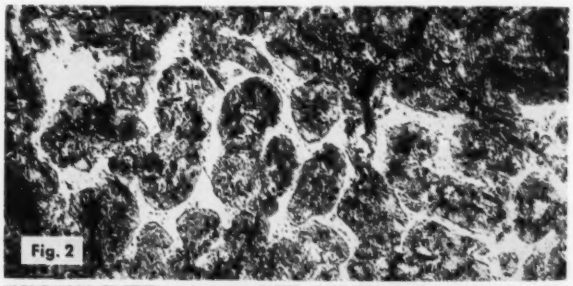


Fig. 2

Fig. 3

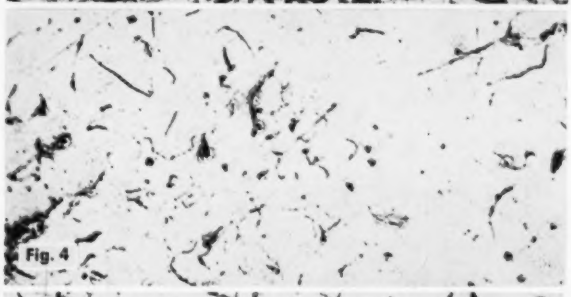


Fig. 4

Fig. 5

Heat Treating Abstracts

High speed, close tolerance production of 3.5 in. bazooka rocket bodies is achieved in the Christy Park Works of National Tube Co. by use of a mechanized salt bath installation used for all heating functions. The process was a joint development of National Tube and Ajax Electric Co. engineers.

Ordnance specifications first required that all machining on the rocket bodies be done after heat treating, but this technique was too slow because of difficulty in machining WD4140 steel in the heat treated condition. Through use of the modified austempering process, all machining is now done prior to heat treatment. Tolerances of 0.0012 to 0.002 in. are held without difficulty. Although production figures are not revealed, output runs into the hundreds every hour.

The first step in producing the rocket bodies is a forging operation which develops a neck on the blank. The blank is heated in a 14% sodium chloride, 86% barium chloride bath to a temperature of 2150° F. without the formation of any scale. The piece is at a temperature of 1900° F. when removed from the forging press and immediately passes to a cyclic annealing salt bath operated just below the Ar_1, where forging stresses are relieved.

After being water cooled, the parts are completely machined and then proceed to a three-step heat treatment which includes a slightly modified austempering operation. After heating, the parts are conveyed into a bath having a temperature lower than is usual for quenching this steel. Finally, the parts are drawn at a slightly higher temperature to attain a hardness of between 34 and 39 Rockwell C. After cleaning and a phosphate coating, the parts are ready for assembly. (*Editor's Note:* A similar process for producing bazooka rockets at Oldsmobile Div., General Motors Corp., was described in the article "Rocket Parts Effectively Treated in Mechanized Salt Bath Furnace", Kenneth Rose, MATERIALS & METHODS, January, 1952, p. 90.)

(*From:* "Close Tolerance Steel Parts Austempered Without Distortion", by John Kolb, THE IRON AGE, April 3, 1952, p. 142.)

* * *

A number of component parts of large assemblies, and many small parts that are complete in themselves are made of steel and often require heat treatment to bring out their best qualities. Steels from which parts such as fasteners, spacers, fish hooks, small coil springs and lock nuts are made do not present special heat treating problems because they are usually of ordinary steels. However, such parts are usually made in large quantities and the mass heating of the small pieces creates several problems which require special attention in processing. Some of these problems are:

1. *Precooling*

The large area-to-volume ratio of most small parts makes them capable of extremely rapid cooling. Therefore, caution must be exercised to avoid precooling before the parts are quenched. Precooling can be avoided by (a) quick dumping into the quench by mechanical methods, (b) using thick bottom trays or baskets to retain heat, and (c) enclosing the discharge end of the furnace to prevent cool air from reaching the parts before they are dumped into the quench.

2. *Conveying*

There are some special difficulties in moving masses of small parts through the various heat treating stages without losing parts, without excessive tangling with some shapes of parts and without blanketing when carbon restoration is desired. Simple parts can be conveyed readily by means of boxes, baskets and trays in which the parts remain throughout the processing cycle. More difficult shapes can be handled by the use of rods, hooks or special "Christmas Tree" fixtures, upon which the parts are individually hung.

3. *Decarburization*

Some loss of surface carbon is not important to many parts, but for many others, soft skins cannot be tolerated. Thus, protective atmospheres are used for many small parts. In other instances, carbon must be restored to the surfaces through the processes currently in vogue.

The author cites the methods used by several companies to handle such problems as these in the treatment of wire springs, lock washers, small bolts, small steel stampings and spring clips for machine gun cartridges.

(*From:* "How To Harden Small Steel Parts", by Kenneth Rose, MATERIALS & METHODS, April, 1952, p. 112.)

LOVE'S WONDERFUL: COMMUNIST STYLE

Certainly we Americans appreciate the efficiency of the machines in our factories and the fact that they have helped make us the strongest industrial country in the world. But do we fall madly in love with them?

Communist newspapers in that part of Germany which is under Russian rule are praising an 18-year-old girl because she did just that, and wrote a poem about it. Poem follows:

"I love you because you are beautiful,
"You shine in the sun and you are so strong,
"You give me new courage when I am disheartened;
"You, my friend the machine."

Get This Book

...A HANDY "INFORMATION FILE" ON FASTER, MORE ACCURATE HEAT TREATING!

HOUGHTON'S "LIQUID SALT BATHS"—a 32-page book covering general heat treating applications for salts—frankly tries to "sell" you on using them more widely.

It gives you the reasons why you get better results with salts. Shows you how they provide rapid, uniform heating. Tells how salts eliminate scale, reduce cracking, lower production costs. Describes the properties of Houghton salts, illustrates their benefits to you, provides you with charted proof.

Send coupon for your copy. It will be mailed without cost, promptly. A valuable addition to your file of heat treating aids.

... products of

E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service ...

HEAT TREAT ALUMINUM IN ⅓ TIME WITH DRAW-TEMP 430

Pure, doubly refined—and exceptionally safe—this salt is widely used in treating aluminum alloys like aircraft parts. Meets requirements of MIL-L-10699, Class 2. Try Draw-Temp 430.

E. F. HOUGHTON & CO., PHILADELPHIA 33, PA.

Please send me your 32-page book, "Liquid Salt Baths"—without cost.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

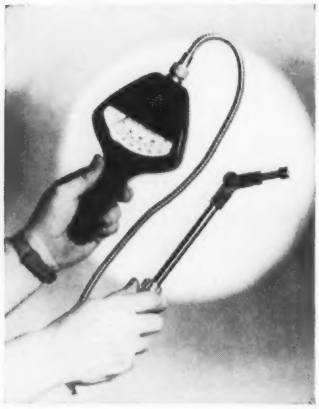
News to Heat Treaters...

New Kraft Chemical Division

Gerald G. Kraft of The Kraft Chemical Company, 917 West 18th Street, Chicago, announces the formation of the Kaynide Division to better serve the needs of the metal finishing industry. This new Division will be devoted exclusively to the plating, heat treating and allied metal finishing industries, and will take over the sale and warehousing of chemicals, anodes, processes, equipment and plating supplies, formerly sold by the Kraft Chemical Company.

* * *

New Hand Pyrometer With Two Scale Ranges



A new hand pyrometer with two scale ranges for the rapid and convenient measurement of surface, liquid, gas and molten-metal temperatures has been announced by the General Electric Meter and Instrument Department.

Designated as the Type FH-1, the new pyrometer is said to be especially useful where a temperature detector does not need to be installed permanently. Its two scale ranges are 0-500 F and 0-1500 F, and the change from one scale to the other is accomplished by the flick of a switch.

Three interchangeable tips available for the new pyrometer include a surface tip, an immersion tip for liquids and molten metals, and a two-prong contact tip.

The automatic cold-junction compensation feature of the FH-1 is intended to eliminate the need for manual adjustment of the pointer for variations in temperature of the instrument or its surrounding atmosphere.

Typical applications include temperature checks of plastic molds, ovens, alloys with low melting points, and pre-heated metals for welding.

* * *

American Wheelabrator Announces Promotion

American Wheelabrator & Equipment Corporation, Mishawaka, Indiana, manufacturer of Dust Collectors and Abrasive Blasting Equipment, announces the promotion of Andrew B. Stevens to the position of Assistant Factory Manager. He has held the position of Supervisor of Production Control and Stores with the company for the past six years.

Name Change

Latrobe Electric Steel Company, Latrobe, Pennsylvania, announces a change in the company name to Latrobe Steel Company. This change was made to more accurately describe the company's products and business as they are today, the company states.

* * *

Examples of Wet Blast Cleaning

Many heat treating shops have adopted wet blasting for removing the scale from hardened parts because it offers such close control over the abrasive action, making it possible to clean precision-built parts without altering close tolerances. The use of very fine mesh abrasives makes it easily possible to maintain tolerances to .0001 inch. Sharp edges or corners and thin-walled sections remain undamaged. Fig. 1 shows a typical cleaning operation of a hardened part in the Liquamatte, a new wet blast machine manufactured by American Wheelabrator & Equipment Corp., Mishawaka, Indiana. Fig. 2 shows various typical precision-built parts for which the process is used. Some are in a scale-coated condition, and some have been blasted.

(Continued on page 21)

Fig. 1 Above

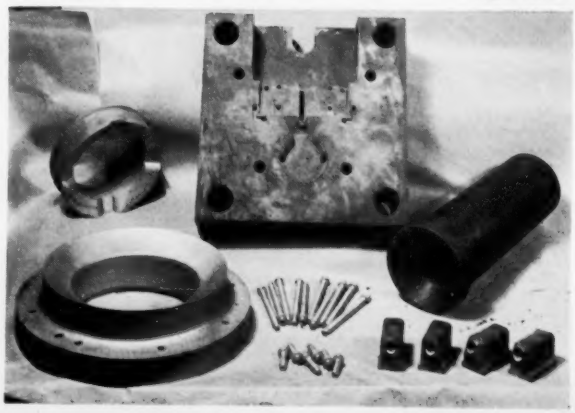
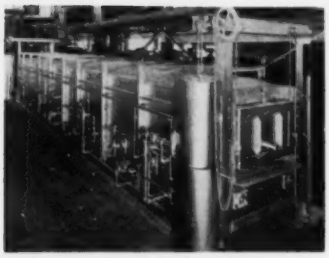


Fig 2 Below

Forty-Foot Oven Furnace Will Preheat Investment Casting Molds



The longest standard heat treat furnace ever built in the Toledo plant of Surface Combustion Corporation was recently delivered to Whitehall Precision Castings Division of Michigan Steel Castings Co., Whitehall, Michigan. This complete double-end furnace, 40 feet long from door-to-door, will be used by this manufacturer for highly critical preheating and thorough dewaxing of molds during their precision casting operations by the "lost wax" process. Five progressive zones each with automatic temperature will insure maximum dimensional stability through controlled expansion of the investment mold.

* * *

Profit Sharing Meeting

The Council of Profit Sharing Industries will hold its annual meeting in Philadelphia at the Ben Franklin Hotel on Thursday and Friday, November 6th and 7th.

Three members of Metal Treating Institute are members of the Profit Sharing Council, namely, Commercial Steel Treating Company of Detroit, J. W. Rex Company of Lansdale, Pa., and Metlab Company of Philadelphia. Mr. Luke Miel, President of Commercial Steel Trtg. Co., has been a pioneer in the work of the Council and is chairman of its Legal Committee.

The profit sharing idea, when well planned and administered, has met with outstanding success. Not only does it appear to be well adapted for the commercial heat treating industry, but may well be the solution to some of the serious industrial-relation problems with which this country is now plagued.

Those who are interested in the program of the Council or in attending the annual meeting should communicate with the Editor of METAL TREATING, or directly with Mr. Joseph B. Meier, Executive Secretary, Council of Profit Sharing Industries, First National Tower, Akron 8, Ohio.

* * *

Labelon Tape

Labelon Tape, the new pressure-sensitive labeling tape on which you can write and which becomes a water-proof, oil-proof, and smudge-proof label is now available in a total of four colors, seven widths, and two roll lengths, the Labelon Tape Company, 450 Atlantic Avenue, Rochester 9, New York, recently announced.

Made of two layers of acetate with a white waxy substance laminated in between, Labelon derives its unique writing qualities from the pressure applied by pencil, stylus, or other blunt instrument rather than from lead or ink.

The pressure-sensitive adhesive, which requires no moistening, adheres to glass, wood, metal, plastics, and ceramics.

Uses: Labeling rod and bar stock, storage bins, spare parts, work in progress, jigs, fixtures, etc. The four colors and seven widths allow for numerous coding possibilities.

* * *

Electric Box Furnace

The Cooley Electric Manufacturing Corporation, Indianapolis, Indiana, are manufacturing a new larger size Type BL Electric Box Furnace. The furnace provides a chamber size of 15"x12"x30".

The design of the BL furnace is said to provide some important new advantages:

1. It employs the Cooley embedded type of heating unit which protects the heavy element wire from atmospheric attack.
2. The elements, formed in ceramic slabs, are located in each side, the bottom, top, rear wall and the door of the furnace to give maximum and uniform distribution of heat.
3. In addition, advantage is taken of the slab shape of elements to cause them to act as baffle walls. Unrestricted air spaces completely surround the elements and a natural air convection is thus created, further equalizing the temperatures.

All sizes of the BL furnace are designed for operating temperatures to 2000° F.

LET THE WAR FIT THE BUDGET

It seems that right after the big shooting war with the British, General George was trying to sell Congress the idea of maintaining a national army. But with the ended, the Congressmen were in no mood for a whopping military establishment.

One Congressman suggested that any national army be limited to 3,000 men. Washington was asked for his opinion.

"Gentlemen," said George, "I see nothing wrong in limiting our army to 3,000 men. But I do suggest an amendment making it illegal for an enemy to invade this country with more than 2,000 soldiers!"—*Tool Steel Topics.*

LETTERS TO THE EDITOR

Dear Editor:

From time to time members of our organization have passed on to me your magazine "Metal Treating", which contains much timely and pertinent information of considerable help to my associates and myself.

In order to have your valuable magazine available at all times and to obtain it regularly as soon as it is issued, I wonder if you would be kind enough to put me on your mailing list. While we do not do any heat treating ourselves at this time, other subsidiaries of Rockwell Manufacturing Company have installations for heat treating. Moreover, we send out a large tonnage of parts to be heat treated every month and my duties make it mandatory that I keep well informed of developments in the heat treating field. Therefore, receipt of your magazine would be of inestimable value in the proper execution of my duties.

HANS J. HEINE
Chief Metallurgist
Rockwell Manufacturing Company
Barberton, Ohio

Dear Editor:

As you undoubtedly know, we at Battelle Memorial Institute are very interested in the problems of the heat-treating profession. We have had an occasion to read your very interesting publication in this field and would appreciate it very much being placed on your mailing list.

J. H. JACKSON
Supervising Metallurgist
Battelle Memorial Institute
Columbus, Ohio

Dear Editor:

Frank McKnight, foreman of our small parts department, informs me that he has had an opportunity to read several issues of METAL TREATING and has found a good many helpful tips in it. He asked if it would be possible for him to be placed on the mailing list.

He says he can get much more out of this than out of some of the larger trade journals because it is written specifically for the heat treater and is not too bulky.

Metlab Co. *F. S. SMYTH*
Philadelphia, Pa. *Secretary, Metlab Co.*

Dow Furnace Appoints

Appointment of Floyd E. Harris as member of the board and Chief Research Consultant of The Dow Furnace Company has been announced by D. B. Dow, president.

For the past 35 years, Mr. Harris was Furnace Engineer, Buick Division of General Motors, and has just recently retired. In that capacity he became one of America's foremost authorities on furnaces and the heat treatment of steels. At The Dow Furnace Company Mr. Harris expects to expand the uses of batch-type controlled atmosphere furnaces.

Mr. Harris is an active member of the A.I.M.M.E. and the A.S.M. and for many years has been a contributor to the Metal Handbook and other publications on controlled atmosphere heat treating and furnaces.

* * *

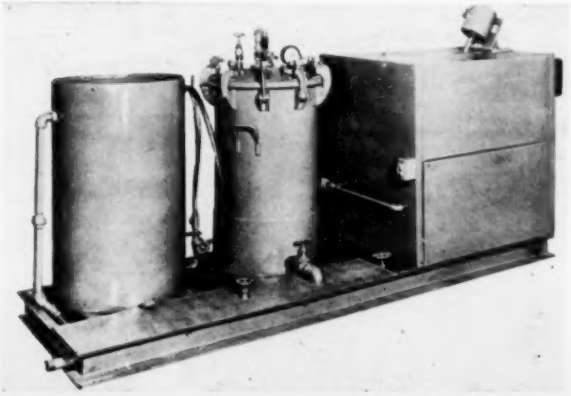
Announce New Impregnating Equipment Eliminates Porous Castings

A new machine for production line impregnating of castings, eliminating their porosity, is announced by Metallizing Company of America, Chicago. The unit, called the Model M-30 Mogullizer, is designed to help overcome the present material shortage by sealing both leaking and weeping castings – ferrous and non-ferrous – under a high vacuum.

Castings to be impregnated must only have minute porosity, fissures or pinholes present. Placed in the unit's sealing tank, they are first subjected to a 29½" vacuum (highest in the field) for 20 minutes, removing all air and moisture from their inner walls.

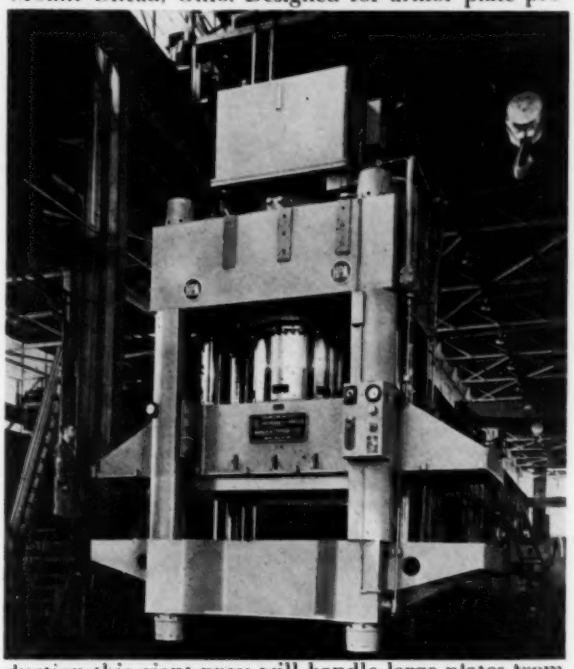
Next, an impregnating solution, such as the Mogul Cast Seal Colloidal, is introduced into the vacuum tank covering the castings. This is followed by application of 100 pounds air pressure for another 20 minutes, forcing the solution into the casting walls from all directions. When the remaining solution is withdrawn to its tank, the castings are removed and rinsed in plain water.

According to the manufacturer, pressure castings sealed by this process have been subjected to severe tests with such solutions as hot oil or kerosene under pressures as high as 10,000 p.s.i.



2500-Ton Armor-Plate Quenching Press

Ready for shipment is one of several H-P-M 2500-ton armor plate quenching presses now being built by The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio. Designed for armor plate production this giant press will handle large plates from ½" to 2" thick. It has an overall bed size measuring at ends, l. to r. and front to back, 72" x 235". Clearance between rod shields, l. to r. and front to back is 98" x 72".



Hot armor plate from the hardening furnace is placed in the press and held under pressure between dies while being sprayed with cold water.

Prior to the development of this hydraulic press quenching method, the plate had to be straightened after it was cooled, employing mechanical presses and permitting only a small portion of the plate to be straightened in the press at one time. This slow and tedious process taking hours is now handled by the H-P-M armor plate quenching press in less than two minutes and eliminates entirely subsequent straightening operations.

* * *

Barber-Colman Buys Wheelco

Barber-Colman Company, of Rockford, Illinois, has purchased the principal assets of Wheelco Instruments Company, of Chicago. Wheelco products consist of indicating, recording, and controlling industrial instruments, and combustion safeguards.

Present plans are to continue current operations in Chicago until such time as manufacturing facilities can be gradually transferred to Rockford in a manner that will result in very little interruption in shipments. No changes are contemplated in Wheelco's national sales and service organization.

Barber-Colman Company entered the automatic control field in 1926, and is now recognized as one of the leaders in the industry. *(Continued on page 22)*

Temperature Indicating Paint

Tempil® Corporation of 132 West 22 Street, New York 11, announces that it is now in a position to supply reasonable quantities of Thermindex temperature-indicating paint for research and development work.

Thermindex temperature-sensitive paints are available in 16 basic shades which undergo color changes at predetermined temperatures. Many Thermindex paints exhibit successive color transformation at several temperature levels.

Thermindex paints have proved very useful in the investigation of heat-treating processes: for safe-guarding bearings, motors, and other equipment against overheating; in determining the heat-transfer qualities of lubricants; in establishing the efficiency of air-cooling arrangements (as for instance in internal combustion engines); in the detection of faulty insulation of high pressure steam lines; and in innumerable development and production problems where temperature is a critical factor.

* * *

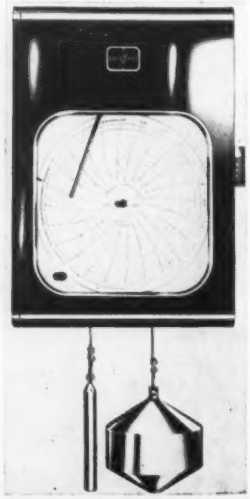
Address Change

Bigelow-Liptak Corporation has moved to new and larger quarters and are now located at 2550 West Grand Blvd., Detroit, Michigan.

* * *

Open Channel Flow Meters

The Bristol Company, Waterbury 20, Conn., announces its new line of Series 500 Open Channel Flow Meters for measuring, recording, and controlling the flow of water, sewage, industrial plant effluent and other liquids. The new meters supersede the Model 40M line formerly manufactured by the company. The flow is determined by measuring the head of liquid flowing through a flume or over a weir in the flow channel. This measurement of head is interpreted by means of a cam, out to the equation of the weir or flume, into terms of flow, which is then recorded on a uniform chart and integrated if desired.



Institute News

REGIONAL MEETINGS

Two MTI Regional Meetings were held recently; one in New York at the Hotel Lexington on March 28—the other in Pittsburgh at the Hotel William Penn on April 25.

In New York a total of 20 representatives from eleven member companies were present. The meeting was opened for discussion by President Rex and a report of current activities and the progress being made with respect to "Metal Treating" was presented by Secretary Herington.

After the meeting Metropolitan Chapter Chairman Don Knoch was host to the group at a very enjoyable party at the Placé Elegante.

In Pittsburgh, 12 were served and representatives came from Detroit and Cleveland. A lively discussion on various subjects of interest followed the dinner, in the usual manner.

The Detroit group reports that they have established definite procedures for their meetings which take place the last Thursday of every month, except during the summer. They have inaugurated a plant visitation program with their group member plants being visited in Alphabetical order. The idea is for the group to become well acquainted with each others' facilities so that they can all provide maximum service to their customers, particularly with regard to specialized operations. Plant visitation is followed by dinner.

MEMBER EXPANDS OPERATIONS

Metallurgical Control Laboratories, Minneapolis, informs us of the opening of a new heat treating plant in Kansas City, Missouri, under the name of Metallurgical, Inc.

MEMBER HONORED

George H. Porter, President, George H. Porter Steel Treating Co., Cleveland, Ohio, was recently elected the Sixth District Vice-President of the National Association of Purchasing Agents, for the period of 1952-53. The Meeting of the Sixth District of the N.A.P.A. was held in the Lawrence Hotel, Erie, Pa.

ANNUAL SPRING MEETING

Representatives of the Commercial Heat Treating Industry gathered from all parts of the United States for the Annual Spring Meeting of the Metal Treating Institute, held at the Lake Placid Club, Lake Placid, New York, May 21-23, 1952.

The members attending greatly enjoyed some excellent technical discussions which were given as follows:

"The Heat Treating of Tool Steels"—H. G. Johnstin, Vanadium Alloys Steel Co.

"Insurance for Heat Treaters"—C. T. Easterby, representing Lloyds of London.

"Evolution of Heat Treating in America in the 20th Century"—Prof. Bradley Stoughton, Lehigh University.

It Really Happened

Theodore Wiedemann was active in the early development of the Metal Treating Institute and was one of its vice-presidents. He was founder and president of the well-known Wiedemann Machine Company of Philadelphia, MTI member, whose heat treating department is now operated by his nephew Joseph Bockrath.

Another story, with a punch, he used to tell about his early experiences as an apprentice heat treater in the old country. As a boy of twelve he did odd jobs around the blacksmith shop, operating the bellows, and swept up. He longed for the day when he would be allowed to forge and harden a steel tool.

One day the head blacksmith handed him a tool and said, "Here, harden this". Overcome with pride he stuck the end of the chisel into the coke fire and pumped the bellows lustily. When he judged the tool had reached a "cherry red" he pulled it out, but lo!, the end of its was gone! The blacksmith came over and boxed his ears in the good old-fashioned way, and said, "Now the next time be sure you *know your metal* before you start heat treating. That was lead".

Manufacturers' Literature . . .

The literature listed below contains information of interest to heat treating organizations. For your copy write direct to the manufacturer and be sure you mention seeing it reviewed in "Metal Treating."

FHP MOTOR SLIDEFILM ADDED TO G-E MOTOR SELECTION AND APPLICATION COURSE

A 35-mm, black-and-white, sound slidefilm and allied literature on "Selection and Application of Fractional Horsepower Motors" has been announced by the General Electric Company, Schenectady 5, N. Y.

The new film (running time 21 minutes) describes the broad uses of FHp motors in the home, on the farm, in factories, and offices.

With photographs, charts, graphs, and cartoons, the slide film outlines the five basic steps that must be considered in selecting and applying any motor, and shows how they work in FHp sizes.

NEW LITERATURE

Carlingo Commodities Corporation, 15 William St., New York 5, N. Y., have a new 12-page bulletin entitled "Peddinghaus Surface Hardening Equipment." This booklet describes the equipment available in the form of machines and attachments which may be used to make use of city gas in place of acetylene in flame hardening operations.

COMBUSTION HANDBOOK

The new Combustion Handbook, published by North American Manufacturing Co., Cleveland, O., contains 322 pages of vital information concerning industrial fuel burning problems, including 178 tables, charts and illustrations. It contains a glossary of terms used in the combustion industry—first ever published—and over 3000 entries in its index.

The North American Combustion Handbook contains no advertising. It is both a text and a reference work. Cost $2.00 each plus postage.

BRISTOL PUBLISHES BULLETIN OF NEW ELECTRONIC STRIP-CHART POTENTIOMETERS AND BRIDGE INSTRUMENTS

The Bristol Company, Waterbury 20, Conn., has just published a bulletin (P1245) describing its line of Dynamaster Electronic Potentiometers and Bridge Instruments for industrial plant, pilot plant, process, research and laboratory use. The 36-page bulletin gives information concerning a number of new electronic instruments for recording and indicating such variables as temperature, pH, speed, voltage, power, current, smoke density, thickness, strain, and a wide variety of other variables which can be measured in terms of d-c current, d-c voltage, resistance, or capacitance.

CONTINUOUS BLAST CLEANING

"Continuous Airless Blast Cleaning" is the subject of a new bulletin, #844, just published by American Wheelabrator & Equipment Corp., 1175 S. Byrkit St., Mishawaka, Indiana.

Of particular interest to shops having the problem of cleaning relatively large tonnages on a production basis, the bulletin explains the process of continuous blasting and illustrates how it is being applied in actual practice.

DIRECT-FIRED HEAT TREAT FURNACES

A new bulletin (SC-156) on direct fuel-fired furnaces for all types of heat treat processing has just been released by Surface Combustion Corporation, Toledo, Ohio.

Practical applications of direct fuel-fired batch and continuous furnace designs in the ferrous and nonferrous industries are shown, and basic operating data given for each of these typical examples.

General information is also included on the possible applications of convection heating and the utilization of auxiliary materials handling systems.

NEW TEMPERATURE CONTROLS DESCRIBED IN BURLING CATALOG

The Burling Instrument Company of South Orange, N. J., announces the publication of a new 12 page illustrated catalog, No. G-17, which describes their full line of temperature controls.

Special features of this catalog are the additions of four new instruments and inclusion of tables of application and performances for all instruments.

The new additions include the Model V-1C—an electric type with a vapor tight cover; the model HA—for use in pneumatic systems; and the various models Y—temperature controlled valves.

Covered also is the use of Burling Controls for temperatures from minus 300 to plus 1800 degrees F. and in various severe applications.

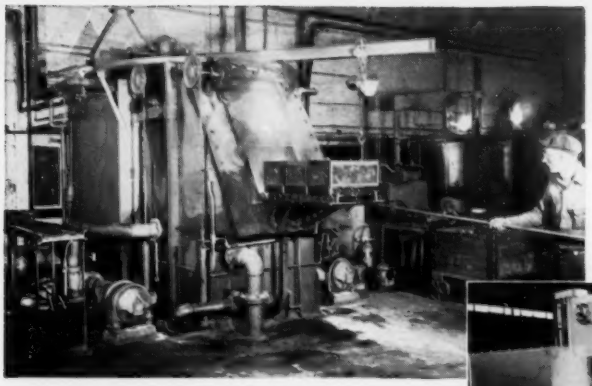
ELECTRICAL MAINTENANCE SERVICE BOOKLET

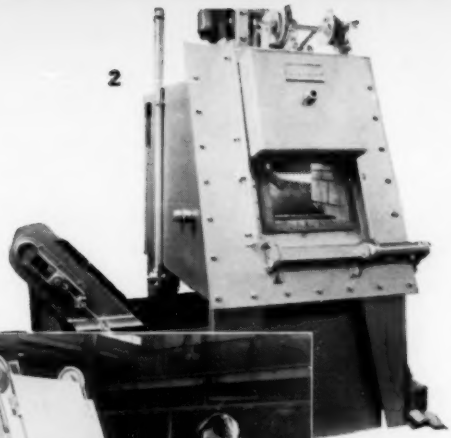
A 24-page booklet (B-4760) describing a complete maintenance service for electrical apparatus can be obtained from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

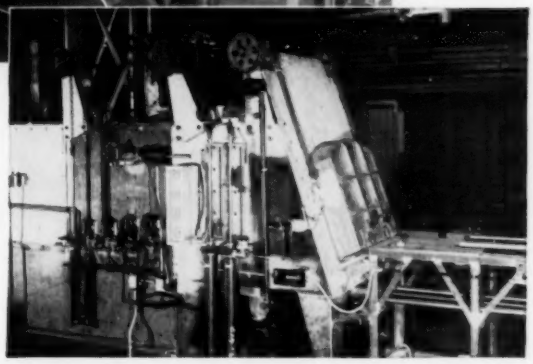
The booklet presents a sound maintenance program based on the use of genuine renewal parts, repair service plants, and engineering and field service. Many improved design renewal parts are illustrated to emphasize the importance of obtaining genuine renewal parts. Motor exchange service, periodic inspection service, and "on the spot" repairs by field engineers are also described.

MICROCARB CONTROL

Leeds & Northrop Co., Philadelphia, Pa., have published a new descriptive booklet entitled "Microcarb Control, Homocarb Method For Production Heat Treating of Steel" which illustrates and describes clearly the equipment, methods and advantages of this system.







1. In Muskegon, Michigan, a Lindberg pusher type furnace carbonitrides bearings for military vehicles.
2. In Delavan, Wisconsin, a Lindberg tilting and vibrating hearth furnace carbonitrides instrument parts.
3. In New York, a Lindberg roller hearth furnace carbonitrides in a commercial heat treat plant.
4. In Evansville, Indiana, a Lindberg pusher type furnace carbonitrides farm machinery parts.

a complete line of

CARBONITRIDING FURNACES BY *LINDBERG*

Lindberg Engineering Company, builders of carbonitriding furnaces for many years, offers a full and complete line including tilting hearth, vibrating hearth, roller hearth and pusher types. Well known manufacturers from all parts of the country have turned to Lindberg carbonitriding for case hardening production runs of low carbon steel parts.

NEW RADIANT TUBE DESIGN . . . Lindberg carbonitriding furnaces now use a revolutionary new type radiant tube. The most important development in furnace construction in years, this new tube, tested and proved in Lindberg research laboratories, completely obsoletes conventional radiant tube design . . . watch next month's issue of this magazine for detailed information on this amazing new development in radiant tube design and construction.

TROUBLE FREE ATMOSPHERE GENERATORS . . . The secret of high quality carbonitriding lies in the atmosphere. With Lindberg, long the nation's largest producer of controlled atmosphere generators, you can be sure of precisely the correct atmosphere.

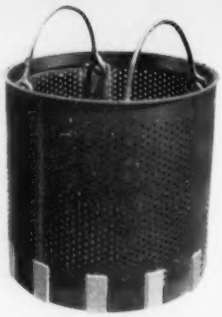
ADVANTAGES . . . Carbonitriding has many advantages. It's an inexpensive, safe, clean process that minimizes distortion. An instructive case-history article in a recent issue of "Iron Age" quotes production facts and figures based on two years' operation of a Lindberg carbonitriding installation in one of the world's largest heat treating plants. Write for your copy!

LINDBERG FURNACES

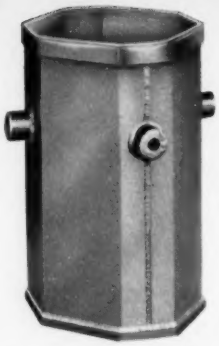
Lindberg Engineering Company

2450 W. Hubbard Street, Chicago, Illinois

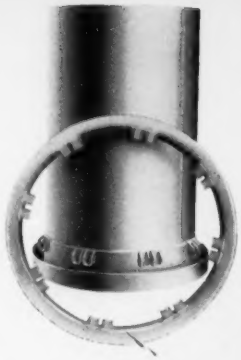
The original PSC carburizing box, now the most widely used in industry.



Perforated basket, illustrating the strength and light weight of PSC units.



An example of the many special-purpose boxes we design and fabricate.



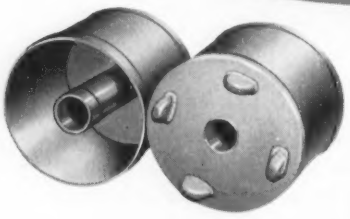
Retort and ring for gas carburizing furnace; all light gauge welded alloy.

for these Carburizing Carriers
PSC issues no claims for super service . . .
but a Good, Time-Proven

Guarantee of Satisfaction

For years we have been guaranteeing PSC carburizing containers. It is our feeling that this gives more assurance than would claims based on cases where PSC equipment gave remarkably long service. Too many variables are involved. We believe what is most important to the purchaser of heat-treating equipment is the breadth and wealth of the maker's know-how. So may we point out that PSC was a pioneer, and is now the largest manufacturer of carburizing containers. PSC welded alloy heat-treating units are furnished in any size, design or metal specification: annealing and carburizing boxes, fixtures, retorts, covers, etc. Send blue prints or write as to your needs.

A "PSC" designed-for-the-job fixture; this one eliminated three handlings.



Chimney type boxes for carburizing ring gears, furnished in any size.

Light-weight boxes for easy handling; yet will not warp. In any size.

Stack type baskets for small lots of different parts in gas furnaces.

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆